Beyond social capital: the norms, belief systems, and agency embedded in social networks shape resilience to climatic and geophysical hazards

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Abstract

Theory suggests that social capital should moderate the impacts of climatic and geophysical hazards and shape adaptive capacities and recovery trajectories, yet the empirical evidence is more mixed than commonly supposed. In short, there is a non-monotonic relationship between social capital and disaster resilience: but what are the reasons for this? We first relate this mixed evidence to the "dark side" of social capital, including bonding capital that is cemented by ethnic hostility, patronage networks, "unresponsive" linking capital, and the conservative nature of social capital. We then argue that the scale-dependent, geographic extent, and *placed* nature of social networks play a critical and oft neglected role in shaping resilience. We turn to discuss the importance of the resources embedded within social networks (financial and human capital), as well as the *content* of the norms, social memories, and belief systems that are propagated across networks. Network functions – in terms of which goals social networks are directed towards, and the specific resources they bring to bear on them - are then discussed. To conclude we suggest that moving beyond social capital towards a combined focus on the

structure, geography and content of social networks offers a promising direction in theorising and analysing resilience.

Keywords: social capital; hazards; social networks; disaster resilience; climate adaptation; vulnerability

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1. Introduction

An influential school of thought hypothesizes that social capital - broadly defined as a measure of the strength and density of network relations - moderates the impacts of climatic and geophysical hazards and shapes adaptive capacities and recovery trajectories, even after adjusting for age, gender, and socioeconomic factors (*e.g.* Klinenberg, 2015; Aldrich, 2011, 2012; Adger, 2003; Burton and Kates, 1963; Turner *et al.*, 1986; Smith, 1981; Sadri *et al.*, 2018). There is a large body of both case studies and quantitative analyses that provide support this hypothesis. However, there is also a significant amount of variation in effect sizes, as well as a non-trivial amount of null-findings (*e.g.* Browning *et al.* 2006), along with some results suggesting that social capital may in some contexts actually *undermine* resilience (*e.g.* Aldrich, 2011; Wolf *et al.,* 2010). This paper is motivated by a desire to systematically explore the sources and nature of this heterogeneity. Its point of departure is that variation in empirical results often indicates problems with how we theorise and analyse a phenomenon, rather than merely reflecting noise or random variation.

To state that the body of literature on social capital and resilience contains some conflicting results is not novel. Indeed there has long been a (sometimes reluctant) acceptance within the field that social capital has a "dark side," meaning that social relations can be used to advance private or sectarian interests at the expense of the public good (Aldrich, 2011; Pelling, 1998). Moreover, it is widely acknowledged that context matters, in the sense that whether social capital contributes to resilience depends on various background variables or dimensions of context (Pelling and High, 2005; Adger, 2003). However, much of the discussion of the dark side of social capital draws from research undertaken in fields other than disaster resilience (*e.g.* organised crime). Moreover, the recognition that context matters often takes the form of ad hoc qualifiers (see also Fine, 2003), with the exception of well-established variables such as state-society relations and the nature of reciprocal relations (Pelling and High, 2005; Adger, 2003). To be sure, context matters, but which dimensions of context influence the operation of social capital, and through which mechanisms? We lack a conceptually oriented synthesis of these drivers of heterogeneity. This not only constrains theoretical development, but also limits the capacity of the field to offer coherent, credible policy advice. Policy makers and authoritative institutions have taken increased interest in social capital over the past 10-15 years, with the World Bank notably promoting it as *essential* for sustainability, resilience, and poverty reduction (Bebbington *et al.*, 2006) (Table 1 sets out the potential policy implications of a link between social capital and resilience). In the absence of a systematic understanding of the mixed results in the scientific literature, there is a danger that the simplified view that social capital is monotonically related to resilience becomes embedded within public discourse and thereby distorts rather than informs policy making. The rapid expansion of empirical work in

the field since the seminal theoretical contributions of Adger (2003) and Pelling and High (2005) makes now a good time to take stock of developments and further refine theory. Moreover, this paper's combined focus on climatic and geophysical hazards seeks to add value through cross-fertilising ideas across two research communities that have tended to operate relatively independently.

This paper draws on the published empirical literature, both qualitative and quantitative, to advance the following research aims:

1) Identify the variables that moderate whether social capital contributes to resilience to climatic and geophysical hazards, and
2) Provide a taxonomy of these variables within the broad framework of social network theories

The latter aim is motivated by the desire to maintain parsimony, as social capital is fundamentally a theory of the nature and operation of *social networks* (although the latter encompasses more than the former).

The paper proceeds as follows. Section 2 provides an overview of the concept of social capital: what it constitutes, how it is measured, and the mechanisms through which it influences resilience (also defined in this section). Section 3 aims to explain the non-monotonic relationship between social capital and hazard resilience. It identifies the variables that moderate whether social capital contributes to disaster resilience. Section 4 summarises the

analysis and offers implications for theory and policy. The basic argument is that the variables identified in Section 3 are not an *ad hoc* list of effect modifiers. Instead, those variables are either consistent with more theoretically refined treatments of social capital,[1] or are attributes of resources embedded in network nodes (*e.g.* human and financial capital), or are things that are propagated and shared across network relations (*e.g.* norms, social memories, perceived collective efficacy), or relate to particular network functions. This suggests that a combined focus on the structure and content of social networks offers great promise for theorising and analysing the social dimensions of resilience.

2. Social capital and resilience: concepts, measurement, and mechanisms

The term social capital may have been coined relatively recently but the core underlying ideas are almost as old as social science itself, namely that:

1) Actors have the capacity to secure benefits by virtue of their membership and position within social networks (Portes, 1998), and

2) Trust, reciprocity and shared norms are prerequisites for collective action which can overcome social dilemmas and achieve mutually beneficial outcomes (Putnam, 1994).

Recent decades have seen a proliferation of work on social capital, with something approaching a consensus emerging that it refers to the relative strength and density of ties between individuals, as well as associated network characteristics such as trust, reciprocity, and the depth of shared norms (Putnam, 2004; Woolcock, 2001; Szreter and Woolcock, 2004). Scholars

[1] Albeit rarely incorporated within measurement frameworks.

vary in terms of whether they conceive of social capital as a property of groups or as an attribute of individuals *and* the networks in which they are embedded (Kiwachi *et al.*, 2008; Lin, 1991). A related debate is whether social capital is best measured at the individual or aggregate level;[2] the prevailing view is that both approaches are valid, and the choice should be determined by one's research questions (Kiwachi *et al.*, 2008). A word on how social networks are commonly conceived. The predominant conception is of networks as pipes (Podolny, 2001) that link actors via flows of knowledge, information and other kinds of resources. Another important concept emphasises the deliberative character of networks and by extension their role in facilitating coordination and collective action (Rockenbauch band Sakdapolrak, 2017).

The measurement of social capital is challenging and contested. Whilst social capital is fundamentally a theory of social networks, empirical work in the field has not widely adopted the standardised measures of social network analysis (SNA) (*e.g.* measures of reachability, density, and modularity; Bodin et al., 2006; Janssen et al., 2006). This is despite the fact that both social capital and SNA researchers take many of the same network constructs as their focus, e.g. the number and strength of network ties, the degree of cohesion, and subgroup inter-linkages (Bodin and Crona, 2009). One reason for this may be that whilst social capital theorists and social network analysts both start from the broad premise that people are social animals and that networking affects social outcomes, SNA researchers do not necessarily make the normative assumptions that social capital researchers tend to adopt (Davies, 2011) – focussing instead on *describing* patterns in network relations - nor do they pay special attention

[2] In other words, is social capital is a collective attribute, or are its benefits associated with individuals and their social relationships (Poortinga, 2006).

to trust and norm-sharing. Notable exceptions include Burt (2000) and Lin (1999) - social capital researchers that work squarely within the formal traditions of social network analysis - although their analytical approach has had little influence on scholars working on hazard resilience. This lack of influence may be rooted in pragmatism: research focussed on quantifying social capital's role in moderating hazard impacts and shaping recovery trajectories is naturally conducted in the aftermath of an event, and as such typically relies on the retrospective development of various proxy measures from archives, census data, or highly aggregated survey measures.

A consequence of the above is that social capital researchers have yet to reach consensus questions of variable selection and weighting schemes, nor on the extent and process by which measurement should be tailored to fit distinct cultural and geographical contexts (Woolcock and Narayan, 2000; Aldrich and Meyer, 2014; De Silva and Harpham, 2007; Agampodi *et al.*, 2015). Commonly used individual-level survey measures include perceptions of trust, reciprocity, social control, civic participation, as well as intensity, duration, and frequency of network interaction. However, the standard measures of perceived trust have been critiqued for being weakly informative of trust-related *behaviour* in both laboratory and real-world settings (*e.g.* willingness to loan possessions; Glaeser *et al.*, 2000; Bowles and Gintis, 2002). A plethora of community-level measures have been used in ecological studies, from blood donation levels to charitable contributions to church membership. However, concerns have been raised about the extent to which they represent the construct of interest (*e.g.* perhaps regular church attendance implies acceptance of strong ethical constraints on behaviour, rather

than a rich social network to rely on in times of crisis; Durlauf, 2002). Another limitation worth noting is that commonly adopted measures rarely focus upon or capture the *resources* embedded within social networks (wealth, status, knowledge, *etc.*). Below we overview theory and evidence on the mechanisms through which social capital influences resilience.

It is now relatively commonplace to draw on concepts of homophily and hierarchy to split social capital into three components: bonding, bridging, and linking capital (Woolcock, 2001; Szreter and Woolcock, 2004; see also Granovetter, 1973; Burt, 2000). Table 2 defines these kinds of capital and outlines the mechanisms through which they may contribute to resilience. Classical sociological theory emphasises the "goods" of social capital, however, more recent work has drawn attention to the "dark side" of social capital - emphasising that it is by its very nature exclusionary,[3] that it may impose significant costs on group members, and that, similar to other stocks of resources, it can be put to pathological uses (the classic example being organised crime) (Putnam, 2004; Portes, 1998, 2014). Work in the risk, hazards, and climate adaptation fields has drawn on this line of thinking (Adger, 2003; Aldrich, 2012; Pelling, 1998). We develop and synthesise these ideas later in the paper.

An important distinction is that social capital can both mediate and moderate the impacts of hazardous events on communities. Mediation refers to the situation where a disaster changes the level of social capital in a community, and this change in turn influences the outcome

[3] The idea is that bonding capital, in particular, relies on a distinction between in-groups and out-groups. However, bonding capital may be used in service of functions that generate social goods – in other words, that deliver benefits for both in-groups and out-groups – such as the volunteer-led creation of dams in flood-prone communities.

variables of interest (*e.g.* fatalities, levels of posttraumatic stress disorder (PTSD), recovery trajectories, *etc.*). This typically involves a reduction of social capital, *e.g.* through residents leaving the disaster area for temporary settlement, or where the stress of coping with trauma erodes interpersonal ties (Bonanno *et al.*, 2010). This in turn may have negative immediate consequences (*e.g.* the accompanying decline in levels of informal social control may lead to looting; Aghabakhshi and Gregor, 2007; Tierney, 2006) and threaten longer term recovery (*e.g.* residents forced into temporary homes may lose their support networks, which has been associated with higher levels of PTSD). Attributing variations in recovery outcomes to disaster-induced variations of social capital requires strong analytical assumptions (but see Hikichi *et al.* 2016 and Kaniasty and Norris, 1993, for excellent analyses). Moderation, on the other hand, explores the extent to which levels of (pre-disaster) social capital explain variations in impacts and in the speed and quality of adaptation and recovery efforts. This is a more tractable question, and is the focus of the literature and our subsequent analysis.

We end this brief overview by acknowledging that resilience is a contested concept (Brown, 2014; de Bruijn *et al.*, 2017). However we skirt around this issue given that resilience does not play a theoretical role in our analysis, but rather serves as a convenient umbrella term for the capacity of communities to prepare, absorb, adapt to and recover from hazardous events.

3. An extended theory of the relationship between social network properties and community resilience

3.1 Kinds of network relations

Here we build on Putnam's (2004) insight that social capital is not a singular thing, of which an individual or group may have high or low levels, but rather a conceptual schema encompassing many categories or types of social networks, which operate in different ways, with different purposes and effects. In particular, we focus on different *kinds* of network relations, in terms of the origins of bonding capital, the basis of reciprocity, and the nature of interactions between communities and formal institutions (summarised in Table 3). We address these in turn before exploring the conservative nature of social capital, and the implications of this for resilience.

It is well established that bonding capital is by its nature exclusionary, and can be deployed to mobilise collective action that harms the interests of (vulnerable) out-groups. For example, Aldrich and Crook (2008) found that neighbourhoods with higher voter turnout (a proxy for bonding capital), were better able to resist placement of temporary trailer housing in their areas following Hurricane Katrina. Particularly severe problems can arise if bonding capital is rooted in ethnic or racial identities, as this can introduce cleavages between groups that are difficult to reconcile, and that moreover may be actively exploited by institutions post-disaster as a way of reinforcing power or deflecting blame. An example of this phenomenon took place following the 1923 Kantō earthquake in Japan. The context was one of historic racial enmity between the Japanese and Koreans, combined with the recent influx of Korean immigration in a time when employment opportunities were scarce, together with post-disaster hysteria and the closing of normal communication channels (Allen, 1996). This created conditions in which Japanese residents were able to use social networks to propagate rumours stigmatising the behaviour of the Koreans (*e.g.* claiming that they had poisoned the wells), and to mobilise

collective action (vigilante units) to persecute and co-ordinate violence against them, seemingly with (implicit) state support (Allen, 1996). Similar problems occurred in Thailand followed the 2004 tsunami, where unsubstantiated media reports of Burmese looting intensified anti-immigrant sentiment among sections of Thai society leading to the arrest, extortion, and sometimes deportation of Burmese immigrants (Larsen *et al.*, 2011). Moreover, the widespread fear of deportation and abuse amongst the Burmese constrained their search for relatives (Larsen *et al.*, 2011).

The risk and hazards literature generally treats reciprocity as an unalloyed good. However, some of the more harmful manifestations of social capital – nepotism, cronyism and clientelism – are directly attributable to the underlying basis of reciprocity. These kinds of reciprocity can undermine resilience in various ways: NGOs favouring their microcredit borrowers and soliciting bribes during the distribution of relief funds (Islam and Walkerden, 2015); village headmen misappropriating post-tsunami emergency provisions and allocating them to the family and friends of local elites (Larsen *et al.*, 2011); elites using their networks to secure approvals for rebuilding projects that violate planning regulations (Larsen *et al.*, 2011); and large-scale fraud and corruption, *e.g.* where drought-relief money was allocated towards "phantom workers" and to non-existent trucks that were contracted to deliver safe drinking water following drought in north-eastern Brazil (Finan and Nelson, 2001). It is important to distinguish between corruption or clientelism on the one hand, and custom on the other. Consider the role of panchayats - local, informal systems of governance, often connected to formal state institutions - in allocating post-tsunami recovery aid in South Asia (Aldrich, 2011).

Aldrich (2011) observed that villages with high levels of bonding and linking capital received both greater volumes of aid, and more rapidly, than those villages holding merely the former. However, the aid was allocated *within* villages in a way that systematically excluded non-members of panchayats, such as Dalit, the elderly, tribal groups, and women. Similar issues arose in the distribution of post-tsunami aid in Samoan society, which was delivered first to the chiefs, who kept the most desirable items for themselves before distributing the remainder throughout the village according to each person's status (Binder and Baker, 2016). Rather than interpreting these examples in terms of corruption, they are probably better viewed as cases where local customs guide the division and distribution of recovery aid in ways that are inconsistent with the rule of relative need.

We now turn to the kinds of relations between community groups and formal institutions. Macro-level institutions – such as the rule of law, property rights, civil liberties, electoral competition, court systems, and press freedom – have strong impacts on the development and activation of social capital (Bisung and Elliot, 2014). For example, certain kinds of community networks and forms of collective action may be perceived as posing challenges to existing power structures, particularly during periods of crisis. This can result in official attempts to constrain social networks and undermine collective efficacy and by extension weaken community resilience, for example by restricting the range of acceptable mitigation or recovery actions, scrutinising and censoring the content of information that is disseminated within and

across networks (Halvorson and Hamilton, 2007),[4] or attempting to co-opt or "capture" civil society organisations (*e.g.* through selecting and training "community leaders" in isolation of local input (Goulden *et al.*, 2013)). The result may be to create passive and dependent communities, either by damaging their stocks of social capital or through suppressing their capacity to activate them. This is borne out by Rubin's (2015) analysis of flood response in Vietnam. He highlights the puzzle that whilst Vietnamese communities had relatively high levels of bonding capital by conventional measures, this did not translate into endogenously driven community initiatives post-flooding. One explanation for this is that the particular form of state-society relations in Vietnam - characterised by limited political accountability, formal barriers to civil society movements, centralised and technologically-oriented approach to disaster management, and top-down, linear communication - crowded out and hindered community-led initiatives (Rubin, 2015).

It is important to emphasise that ritualistic and superficial institutional practices of engaging the public and civil society groups is not restricted to lower and middle income countries. In advanced democracies, public engagement on issues of risk and resilience often takes place after the technical analysis has been undertaken, leaving little space for public scrutiny or participation, perhaps reflecting an ambition to manage or dampen controversy rather than secure meaningful public engagement (Wynne, 2006; Lane et al., 2011). For example, in the aftermath of the tsunami Japanese authorities sought to dampen public anxiety by withholding

[4] For example, community activists who were vocal critics of the role of official corruption in the sub-standard construction of schools across Sichuan province – devastated by the Wenchuan earthquake in 2008 – were reportedly monitored by state officials and in some cases jailed.

information about radiation levels, underplaying the risks associated with radiation exposure, and even going so far as to threaten individuals who provided conflicting information with prosecution (Aldrich, 2017). As well as hindering effective network communication, this ultimately damaged ties between the state and citizens (ibid).

This kind of linking capital has been characterised as "unresponsive" (Putnam, 2004), the implication being that such state-society interactions can simultaneously create dependency whilst neglecting local knowledge, values, and preferences in emergency response and recovery. McSweeney and Coomes' (2012) analysis of the impacts of Hurricane Mitch on a Honduran indigenous community (the Krausirpi) further reflects this theme. They found that pre-disaster state and NGO-led promotion of both forest conservation efforts and a shift towards "environmentally friendly" cacao production had created significant social and economic cleavages within the community that undermined resilience. For example, agricultural specialisation rendered the community susceptible to external shocks, a vulnerability exacerbated by the concentration of orchards along flood-prone river banks. Moreover, cacao income was spread unevenly across the Krausirpi, partly a function of inequality in land distribution stemming from their usufruct system of land holding and transfer. This inequality damaged networks of reciprocity, including food sharing and labour exchange. Combined, this led the poor in particular to be highly vulnerable to external shocks, reflected in the substantial and disproportionate damages to their health, livelihood, landholdings, and finances in the aftermath of Mitch (McSweeney and Coomes, 2012).

"Unresponsive" community-NGO relations can also undermine resilience, as Berke *et al.*'s (2008) analysis of the restoration of tsunami-damaged mangrove ecosystems across six Thai villages demonstrates. Although each village possessed dense social networks and wide agreement on norms, they exhibited marked variation in the extent of collective action in support of restoration efforts. Significantly, the village with the highest level of recovery efforts - in the form of tree appropriation rules, replanting programs, and hiring inspectors to monitor tree cutting - worked with a Japanese NGO who adopted a community-led, bottom up approach to aid delivery. By contrast, aid delivery in the poorer performing villages was top-down in nature, leading to a systematic mismatch between the needs of the villagers and the resources that were delivered, destabilizing bonding capital, and limiting collective action in support of mangrove restoration.

However, even responsive social capital - in the form of risk management networks that are loosely co-ordinated by the state whilst at the same time genuinely decentralised and that rely heavily upon citizen involvement – may be intrinsically conservative. The idea here is that social capital serves as the glue underpinning societal cooperation and ideological conformance, rather than the lubricant of social or intellectual change (Paldam, 2000). A classic example of this is the (historic) Chinese short-term earthquake prediction program. This involved a network of (often) amateur-led observatories, scientists, and state officials that were tasked with interpreting natural phenomena (precursors) to determine whether an earthquake was imminent (Chen and Wang, 2010; Fan, 2007). This "knowledge" was used to generate early warnings and evacuation orders, long after such "precursor hunting" was viewed as

pseudoscience within the seismology community (Chen and Wang, 2010). The program not only generated significant economic and social costs through unnecessary evacuation orders, but also diverted focus and resources away from measures that could genuinely build resilience (*e.g.* enforcing building codes) (Chen and Wang, 2010). The long shelf-life of the Chinese prediction program has been attributed to political and ideological drivers. Following the apparent prediction of the 1976 Haicheng earthquake - the only successful prediction in recorded history - the program became a source of national pride at a time when Chinese scientists were isolated internationally (Fan, 2007). Moreover, precursor hunting was coherent with core tenets of Maoist thought, such as the ambition of mastering nature via prediction and control, as well as representing a critique of "elite" science combined with the veneration of amateur involvement (precursors such as variations in animal behaviour, groundwater levels, etc. being accessible to untrained observers) (Chen and Wang, 2010; Fan, 2007). Finally, it reflected a traditional epistemology - famously embodied in Chinese medicine - that mechanistic knowledge is unnecessary for reliable prediction (Chen and Wang, 2010). Indeed it was only the failure to foresee the catastrophic 2008 Wenchuan earthquake that marked a decisive Chinese shift from short-term forecasting efforts towards an emphasis on mitigating risk and building resilience (Chen and Wang, 2010).

The lesson of the Chinese example is that norm observance, demands for conformity, and social control are in a sense polar opposites of social learning and autonomy. Moreover, it highlights that dominant network actors may stifle the evolution of beliefs and social practices if such changes are perceived to be inconsistent with their ideologies or interests (see also Larsen *et*

al., 2011). In a similar vein, Dowd *et al.* (2014) report case-study evidence suggesting that strong social capital constrains *transformative* adaptation in the Australian agricultural sector through encouraging strict adherence to traditional norms and practices. This notion that (forms of) social capital may be innately conservative is not well reflected in the risk and hazards literature, which perhaps not coincidentally has been critiqued for relying on a concept – resilience – that is focussed on maintaining or returning to a state of social equilibrium (implicitly treating the status quo as normative), rather than ideas of social change or transformation (Olsson *et al.*, 2014).

3.2 Network node attributes (embedded resources)

We now turn our attention to particular attributes of network nodes. Elliott *et al.'s* (2010) study of the devastation wrought by Hurricane Katrina demonstrates that the resources conferred by network membership, and more broadly the contribution of social capital to resilience, is a function of the human and financial capital of network nodes. For example, whilst they observed relatively equal use of social capital across socio-economic strata during the early stages of disaster response post-Katrina, this diverged over time as the emphasis shifted from local towards trans-local ties, which disadvantaged residents were less likely to draw on. Whilst this is probably partly due to the fact that poorer individuals were likely to have comparatively fewer trans-local ties, it is further probable that their lack of financial capital constrained them from using those ties for recovery (*e.g.* lacking means of transportation to visit relatives who may have a spare room), and that the trans-local ties they did possess connected them to similarly disadvantaged individuals who were by extension less well equipped to assist (Elliott *et*

al., 2010). Similarly, they found that the average resident of (the deprived) Lower Ninth Ward needed to know 80 more neighbours than the typical resident of the (affluent) Lakeview area to secure the same probability of pre-storm assistance. Carter *et al.* (2007) report similar results from Honduras, where rates of recovery from Hurricane Mitch were positively correlated with high levels of trust and altruism, yet poor households within these communities remained particularly vulnerable to asset shocks. Part of the explanation for these cases may be that external shocks can shift poorer households into a poverty trap – a new equilibrium state where their already meagre assets are reduced to levels that make recovery near impossible (Carter *et al.*, 2007).

Human capital, in the form of the knowledge required to interpret the signals that a hazardous event is imminent or unfolding, and of how to respond and ultimately recover and rebuild, is another modifier of whether social capital will exert its protective effects. For example, Browning *et al.* (2006) did not detect a significant protective effect for social capital on mortality during the Chicago heat wave, which they speculate may be due to the fact that a substantial proportion of heat-related deaths occurred within two-three days of the temperature rises, potentially before there was a recognition that a crisis was unfolding. Similarly, using survey data from Fiji, Gawith *et al.* (2016) found that social capital was negatively correlated with damages from a tropical cyclone - which meteorologists had warned of in advance - yet observed no protective effect for a river flooding incident, of which there was little advance knowledge or warning. In a recovery context, bonding capital can provide access to loans via community based micro-credit schemes; however, low human capital

individuals may lack the knowledge required to interpret the fine print and sensibly invest loans. Prior experience - or lack thereof - of disasters is a particularly important component of human capital, through increasing the saliency of low-frequency, high-impact events that may otherwise be neglected, highlighting latent vulnerabilities (*e.g.* lack of earthquake-resistant structures), and providing a knowledge base which collective action can exploit to build resilience (Yamamura, 2010).

However, clear, accurate warning signals are insufficient – the message conveyor must also be trusted (*e.g.* the perceived trustworthiness of the warning conveyor is a robust predictor of evacuation behaviour; Thompson *et al.*, 2017). Trust – both interpersonal and generalised – is of course central to the theory and empirics of the social capital field. However, the social capital and resilience literature has placed little to no attention on the trustworthiness of specific risk management institutions tasked *inter alia* with conveying information, advice, and warnings, for example in relation to seismic risk adjustment measures. Perceptions of recreancy or worse on behalf of institutions can significantly impact the uptake or neglect of official advice. For example, Solberg *et al.'s* (2010) study of land squatters in Istanbul uncovered a widespread belief that Turkish engineers, regulators, and the construction industry were corrupt, leading to an increased reliance on indigenous construction techniques that are at marked variance from institutionally sanctioned best practices, and that may have enhanced the vulnerability of the squatters (Green, 2008). It follows that the trustworthiness of particular risk management institutions – rather than more generalised perceptions of trust in the state – is a node attribute that should be taken account of.

3.3 Network geography: scale, scope and context-dependency

Social capital and social networks are of course situated within macro-level structures and processes – state institutions, economic markets - that condition their roles and effectiveness. It follows that social capital's contribution to resilience is likely to be scale-sensitive. It is commonly supposed that social capital is a more significant component of disaster resilience in states that lack (well-functioning) insurance and capital markets, and that do not have basic social safety nets (Wossen *et al.*, 2015; Zarychta, 2015). These propositions are intuitive enough; however, there is a lack of cross-country analysis rigorously testing them. Characterising these scale-interactions requires comparative data about similar social networks in localities with sufficient variation in the interaction variable of interest (*e.g.* market functioning), which is challenging to obtain. There, may, however, be an interesting variation of Simpson's (1951) paradox at work, in that the moderating effect of wealth on social capital's contribution to disaster resilience reverses at different scales of analysis. At the macro scale, social capital is believed to play a more significant contribution to resilience in poor nations (given the relatively underdeveloped capital and insurance markets). However, at the household scale, social capital appears to make a smaller contribution to the resilience of poor than to the resilience of the wealthy, in part because of poverty traps, and in part because the poor tend to be connected to similarly low financial and human capital individuals (Elliott *et al.*, 2010; Carter *et al.*, 2007).

A separate geographical concern is with the scope or extent of social networks. For example, in a study of tsunami-impacted small-scale fisheries in Chile, Marin *et al.'s* (2015) analysis suggests that disaster hit towns that are geographically distant from centres of political power may struggle to maintain visibility to aid agencies and state institutions and by extension face difficulties in attracting resources for recovery efforts, leading to long-term community decline. Elliott *et al.'s* (2010) study of the aftermath of Hurricane Katrina suggests that what matters for resilience is not so much the balance of bonding and linking capital, but rather the balance of local and trans-local ties, particularly following immediate rescue and recovery efforts, by which point local ties have often been stretched to capacity and undermined by community displacement. This is particularly likely to be true for disasters that are covariate shocks (Trærup, 2012), in the sense that the physical impacts are relatively homogeneous within defined geographic radii, leaving few untouched within local boundaries. Similar issues may arise for agricultural communities in the context of climate adaptation. Here, during unfavourable seasonal conditions, ties across geographic space to other agricultural communities (*e.g.* those unaffected by the drought) or to family members in urban communities (*e.g.* in the case of rural exodus), can be of crucial importance in buffering against shocks (Finan and Nelson, 2001), particularly in the absence of well-developed markets. If social capital is genuinely relational, then given modern processes of mobility, migration, and globalisation, analytical perspectives that neglect the spatial dimensions of social relations rather miss the theoretical point (c.f. Sampson *et al.*, 1999).

A final geographic aspect is that the nature or form of social capital is spatially patterned, and whilst this is broadly accepted in theory, methodological approaches are not always sensitive to this. The basic measurement problem is that the field of social capital traces its origins to research in Western, high income nations (Agampodi *et al.*, 2015), yet the nature and operation of social capital is to a significant extent culturally variable (De Silva *et al.*, 2007). To illustrate, measures of kinship, caste, and religious ties may better reflect social resources in Indian villages, rather than variables used in Western contexts such as the density of NGOs and voter turnout (Serra, 2001). Similarly, trade union membership - a common measure of bridging ties - may be of little relevance in regions where informal labour markets dominate (De Silva *et al.*, 2006). An additional problem is that culture conditions how survey questions are interpreted. De Silva *et al.* (2006) found that respondents in low and middle income countries held notions of community, of what constitutes active group membership, and of the nature of social support that differed systematically from those of the researchers. Similarly, membership of organisations closely associated with the ruling party in authoritarian regimes may better reflect patronage networks, membership of which is necessary for extracting rents, rather than reflecting trust or respect (Gainsborough, 2007; Rubin, 2015). Rubin (2015) questions whether the reported high levels of social capital in Vietnam are inflated by the fact that responses to survey measures of trust and reciprocity may reflect the desire of respondents to reflect the official party line (*e.g.* celebrating needs of society over that of the individual citizen). A related source of measurement error is driven by social desirability bias combined with the particular norms of a region. For example, survey responses relating to PTSD may be biased downwards in countries such as Peru, where mental health disorders are strongly stigmatised (Flores *et al.*,

2014). A further complication is that criteria for measuring outcome variables of interest may not necessarily be universal, for example, research suggests that the symptoms characterising PTSD are culturally heterogeneous, implying that standard measures such as the American Psychiatric Association's diagnostic criteria may require culture-specific tailoring (Bolton *et al.*, 2012; Binder *et al.*, 2014). Taken as a whole, this analysis suggests the need for culture-specific frameworks for characterising social capital and its contribution to resilience. However, whilst recent years have seen an expansion of quantitative research investigating social capital's relationship to health (rather than resilience per se) within low and middle income countries (*e.g.* Bisung *et al.*, 2014), this often involves the simple exportation of measurement frameworks developed within Western, high income nations (Agampodi *et al.*, 2015). When adaptation has taken place, there is generally little substantive discussion of the underlying methodology or logic (Agampodi *et al.*, 2015).

3.4 Norms, social memories, perceived collective efficacy, and network functions

Several long standing risk research traditions have examined the role of socio-cultural factors in shaping how hazard signals – whether in the form of expert evaluations of risk, lay observations, or emergency warnings - are propagated, (re-)interpreted, amplified and attenuated as they travel across social networks (Pidgeon et al., 2003; Kahan *et al.*, 2009). These socio-cultural factors are distinguished from the node attributes discussed earlier – such as the knowledge and wealth possessed by network individuals – in that they are better understood as properties of networks or network relations, rather than of individual nodes. These factors – summarised in Table 4 – have received comparatively little systematic attention

in the social capital and resilience literature. The concept and measurement of social capital is, after all, agnostic as to the *content* of norms, beliefs, and practices that are embedded within networks (save for norms directly relating to exchanges across social relations, *i.e.* trust and reciprocity). To understand the problems stemming from this neglect, consider the role of religious belief systems. Theological explanations of hazards such as earthquakes and tsunamis prevail in some Islamic communities, where they are viewed as manifestations of divine retribution or as precursors to Judgment Day (Paradise, 2005). This may have significant (and largely unstudied) implications for perceptions of agency (Solberg *et al.*, 2010), in Bandura's (2001) sense of beliefs about the capacity to exercise control. Sampson and colleagues have been strong proponents of the idea that collective efficacy – shared beliefs or expectations in a community's capability to act in pursuit of a given end – is a crucial mechanism for mobilising social capital in the form of collective action (*e.g.* Sampson *et al.*, 1999). Otherwise, the resources embedded in networks may lie dormant. Religious belief systems may also undermine resilience through constraining the portfolio of adaptation and response activities. For example, Bangladeshi women living on "chars" (river islands formed via sedimentation) are by convention not supposed to leave their homes without permission from their husbands (even to visit cyclone shelters), and the significant public shame attached to (partial) nudity constrains their flood response options (*e.g.* swimming to safety) (Howell, 2003). This may partly explain the striking gender-differences in cyclone fatalities on the Bangladeshi island of Monpura (following the 1970 cyclone, the entire adult female population of the island was lost) (Howell, 2003).

Consider now the role of social capital in shaping the resilience of two nonpoor families in low income rural communities whose head of households had each died suddenly (Barrett and Constas 2014). In one case, bonding capital provided a source of labour, in the form of the extended family sending a male cousin to assist with farmwork, whilst a combination of bonding (neighbours) and bridging (church congregation) capital served as conduits for donations to cover funeral expenses and tuition fees for the children. Here, social networks were a central component of the resilience of the family to the external shock. The other family fared differently. Here, local norms dictated that they slaughter the (sole) family cow for the funeral feast, and allowed the deceased husband's brothers to take over the family's farmland, later evicting the widow and children after they had protested. The family were unable to secure temporary housing or assistance from neighbours, as the high social status of one of those brothers led to the widow and children being ostracised within the community, effectively collapsing their stocks of bonding capital. The family subsequently left their rural village in favour of a nearby urban slum, turning to informal street trade and begging. These contrasting cases - whilst not involving geophysical hazards - convey the core idea that the content of societal norms play a crucial role in shaping the capacity of individuals and groups to recover from external shocks, in some cases magnifying the harm suffered (Barrett and Constas, 2014).

A further example comes from Wolf *et al.'s* (2010) study of the resilience of elderly communities to UK heat waves. They found that (high stocks of) bonding capital may *undermine* resilience through: propagating perceptions that heat waves posed little risk to the elderly;

transmitting norms of self, reliance, capability, and independence as central elements of shared self-identities; and spreading beliefs that "common sense," reactive measures would sufficiently mitigate the dangers posed should such an event arise (*e.g.* stay out of direct sunlight). In a similar vein, Williams et al.'s (1995) study of survivors of a ferry capsize found that a "stiff upper lip" attitude - characterised by an unwillingness to seek help and a negative attitude towards expressing emotion - was associated with lower levels of received social support and higher levels of PTSD. Norms that have instrumental value in some contexts may prove maladaptive in others, and social networks can play important roles in disseminating and reinforcing them. Norm content may also explain variation in resilience within (rather than across) communities: the norm of "women and children first" appears responsible for the dramatic differences in survival rates between male, female, and child passengers on board the Titanic (Hall, 1986).

We turn now to the importance of social memories. Consider the markedly low fatality rates within certain indigenous communities in the Indian Ocean and Pacific Islands following tsunami events (*e.g.* amongst Solomon Islanders, and the Moken tribe of southern Thailand; McAdoo *et al.*, 2006, 2009). These communities lacked the physical infrastructure of early warning systems or communications technology, yet were able to draw on historic knowledge of tsunami events that had been stored and propagated across generations through myths and oral histories (relating to the Laboon, the "wave that eats people;" Sukrung, 2005). The embedding of these histories within cultural memory, together with the rapid informal communication made possible by dense, geographically bounded social networks, ensured that

knowledge of tsunami early warning signals (water rushing away from coral lagoons), and of the relevant responses (head for the hills or deep water), was available and transmitted before disaster struck. Similarly, following the catastrophic impacts of Hurricane Mitch the Krausirpi drew on social memories of more egalitarian land structures to reform their usufruct system of land tenure, which in turn stimulated the diversification of income-generating strategies, increased labour efficiency, reduced rates of deforestation, improved social cohesion, and by extension enhanced resilience (McSweeney and Coomes, 2012). The absence of social memories or other forms of encoding knowledge of warning signals and of relevant responses can render social networks ineffective. Recall Browning *et al.'s* (2006) speculation that the apparent lack of protective effect of social capital on mortality during the Chicago heat wave may have stemmed from the absence of a collective recognition that a crisis was unfolding (generations had passed since the last severe heatwave).

Together, these examples emphasise that the contribution of social networks to resilience is not merely driven by the strength and density of network ties, but also by the *content* of the norms, perceptions, stories, and beliefs that are propagated through those networks. Put another way, network content (*e.g.* actors' shared beliefs, prior experiences, and norms) shapes the (re)interpretation, propagation and amplification of hazard signals, and strongly conditions perceptions of appropriate adaptation, mitigation and recovery options.

A final critical network property is the nature of the reciprocal exchanges. The basic idea is that networks fulfil different kinds of functions – some generic (*e.g.* information sharing), some

specific (*e.g.* land sharing networks) – and that the range and combination of functions fulfilled by a given set of networks within a community will influence resilience levels. There is a dearth of evidence on this, but we offer some speculations. It may be useful to think in terms of overarching resilience or risk management strategies (*e.g.* forecasting; mobility; storage; rationing; selection; pooling; diversification), and to connect these to particular network functions (*e.g.* labour exchange and pooling networks; co-operative associations to manage resource exploitation and buffer oscillations in commodity prices, *etc.*). A focus on network functions and tasks leads naturally to the question of whether resilience should be understood as a hazard-specific property, given that droughts, heat waves and earthquakes differ in terms of their foreseeability, available risk mitigation options, and characteristic damages. For example, agricultural communities facing persistent climate-related hazards (*e.g.* prolonged droughts) will likely have evolved a series of network functions and associated institutions that are tailored to those specific threats – *e.g.* networks for sharing knowledge and technologies on drought agricultural practices, land tenure institutions, co-operative associations to manage resource exploitation and buffer oscillations in commodity prices, and pooled informal insurance networks. Similarly, societies experiencing increasingly frequent flooding often develop network functions that build their resilience in the face of hydrological change (Di Baldassarre *et al.*, 2016). The converse is more likely to be true for communities exposed to hazards with long historical return periods such as volcanic eruptions or tsunamis. This focus on network functions is coherent with Sampson *et al.*'s (1999) extension of the social capital concept to focus on the particular tasks that it helps to achieve, as opposed to the traditional conception of social capital as a stock of generic resources to be deployed in a task-

independent fashion. In short, a focus on network functions seeks to connect the stocks of resources embedded in social relationships (*i.e.* the social capital perspective) with the specific tasks or strategies involved in securing health and welfare in the face of geophysical hazards.

4. Conclusions

Social capital is widely theorised to play a significant role in hazard resilience, yet the empirical evidence is more mixed than is commonly supposed. The overall thrust of our analysis has been to emphasise the contingent nature of social capital's contribution to resilience: the relationship is far from an exact law that holds true across space and time. We view social capital as a fundamentally *placed* phenomenon (c.f. Mohan and Mohan, 2012; Burt, 2000; MacGillivray and Franklin, 2015; Scott, 2014; Berkes and Ross, 2016), in the sense that it is spatially patterned, and that its form and effects are modified by background variables that are unevenly distributed across space. In a sense this should be an uncontroversial argument, as there are relatively few if any exact laws in the social sciences, and indeed our focus on the contingent nature of social capital's contribution to resilience is consistent with the long-standing and primarily theoretical contributions of Pellling and High (2005) and Adger (2003). Our own contribution lies in systematically identify the factors that moderate the relationship between social capital and resilience, and in organising these within the broader framework of social network theories.

We focussed on two broad classes of moderators. The first were factors that are internal to theories of social capital, but that are rarely captured in empirical work on disaster resilience.

These include the dark side of social capital, including: the use of bonding capital to disenfranchise, scapegoat, or exploit out-groups; “corrupt” forms of reciprocity such as clientelism, nepotism, and cronyism; and linking capital that is rooted in authoritarian structures of governance and fundamentally unresponsive to the needs of the citizenry. We also highlighted the conservative nature of social capital, in the sense that it is the glue underpinning cooperation and social conformance, and as such can militate against changes in beliefs and social practices that may be required to build adaptive capacity. We reviewed evidence showing that attributes of individual nodes within networks – such as human and financial capital – condition social capital’s protective effects. These attributes can be seen as embedded resources, and whilst access to resources is a core element of some traditions of social capital theory, they are rarely explicitly measured in the disaster resilience literature. We then turned to the geography of social capital. We argued that the nature and operation of social capital varies by culture, scale, and the geographic extent of social networks. This implies a need for the adaptation of standard measurement approaches for particular geographical contexts and scales; a need typically honoured in the breach rather than the observance.

The second class of moderators, whilst orthogonal to social capital theories, are far from being a disconnected list of curiosities in the sense that they are all aspects of the *content* of social networks. They include: entities that are propagated across network relations (*e.g.* norms, mental models); shared expectations of collective action; and the functions of social networks. We summarise the importance of these three factors in turn. Firstly, the contribution of social networks to resilience is not merely driven by the strength and density of network ties, but also

by the *content* of the norms, perceptions, stories, and beliefs that are propagated through those networks. This may well seem an obvious statement to make, but its importance lies in the fact that the content of norms and beliefs are orthogonal to the concept of social capital, and this neglect is part of the reason for its explanatory limitations. Secondly, shared beliefs or expectations in a community's capability to act in pursuit of a given end is a crucial mechanism for mobilising social capital in the form of collective action (e.g. Sampson et al., 1999). In the absence of such beliefs, the resources embedded in networks may lie dormant. This emphasis on collective agency or active engagement is not well capture by the concept of social capital (ibid). Finally, social networks fulfil different kinds of functions – some generic (*e.g.* information sharing), some specific (*e.g.* land sharing networks) – and the range and combination of functions fulfilled by a given set of networks within a community will influence resilience levels. However, social networks are implicitly treated as task-independent structures within much of the social capital and resilience literature, rather than as structures that are maintained to fulfil towards specific functions that require particular kinds of resources and forms of collective action.

Parsimony is of course an important virtue in science, yet our analysis suggests that moving beyond social capital to focus on both the structure and content of social networks holds great promise for theorising and analysing community resilience. Moreover, our analysis provides grounds for caution for those advocating using social capital as a policy lever to enhance community resilience. There has long been a sceptical line of thinking that (state) interventions are rather clumsy tools for strengthening social relationships (see Adger, 2003). However, even

if such interventions *are* effective in building social capital, we have shown that whether this will in turn build (or undermine) resilience is a function of *inter alia* the norms, practices, and belief systems embedded within social networks.

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Variations in social capital serve as an important proxy for social vulnerability, and thereby could be used as a basis for prioritising state and transnational efforts in poverty alleviation and economic development, and also as a basis for directing emergency response and recovery efforts post-disaster (Pelling and High, 2005).
The inverse correlation between levels of social capital and mental health outcomes (e.g. PTSD) in post-disaster settings implies that where resettlement is required, policy makers should attempt to maintain community links as far as is possible (Hikichi et al., 2017).
Policy makers should make efforts to build social capital within communities so as to build resilience, for example through providing funding, facilitators and arenas for collaboration between diverse actors and institutions across multiple scales ("boundary-spanning networks") (Bodin and Crona, 2009; Schneider *et al.*, 2003).
Policy makers should be careful not to suppress social capital, *e.g.* through being tolerant of civil society organisations and non-state modes of governance (many scholars are sceptical whether the state can directly build social capital through interventions, but they accept that they can (inadvertently) suppress it) (Adger, 2003).

Table 1: Potential policy implications of social capital's contribution to hazard resilience

	Definition	Relationship to resilience
Bonding capital	Bonding capital relates to connections and interactions between homogenous community members such as neighbours and family members. It is rooted in particularised forms of trust and reciprocity (Woolcock, 2001).	Family, friends, and neighbours are often the first responders in crisis situations, being in a position to propagate early warning signals (Gawith *et al.*, 2016) offer instrumental support such as help in boarding windows in advance of an incoming hurricane (Haines *et al.*, 1996), and are often active in search and rescue efforts before emergency professionals arrive on the scene (Aguirre *et al.*, 1995; Zhao, 2013). These "strong ties" are often crucial for securing temporary shelter, in assisting early efforts at rebuilding (*e.g.* via labour exchange), and in recovering livelihoods (*e.g.* sharing means of production, keeping livestock on neighbours farms, *etc.*).
Bridging capital	Bridging capital refers to relations between individuals or groups who are *different* in some socio-demographic sense (*e.g.* ethnicity, culture, age) yet who share broadly similar social or economic status. It has its roots in heterogeneous networks, social trust and generalized reciprocity (Putnam, 2001; van Deth and Zmerli, 2010).	Through providing access to a diversity of resources, skills, and knowledge which may not be accessible through bonding capital alone (Easterly *et al.*, 2006), bridging capital may be an important prerequisite for adaptation in the face of evolving hazards (Dowd *et al.*, 2014).
Linking capital	Linking capital describes relationships that cut across power or authority gradients (*e.g.* connections between communities and NGOs and state institutions).	Linking capital can provide communities with access to a range and scale of financial, technical, informational, and logistical support that could not be sourced endogenously (Pelling and High, 2005). It can play a crucial role in securing the long-term investments required to rebuild the social, economic, and physical infrastructure of communities post-disaster (Marin *et al.*, 2015).

Table 2: Bonding, bridging, and linking capital, and their contribution to hazard resilience

The exclusionary nature of bonding capital	Bonding capital is by definition exclusionary in nature, and can be used in ways that harm the interests of out-groups (*e.g.* via disenfranchising them). This is likely to be a particular problem in polarised communities (*e.g.* those characterised by wealth inequalities, ethnic tensions, or disparities in political representation). Here, latent conflict can manifest in scapegoating or violence in periods of high tension (e.g. the aftermath of a disaster).
The nature of reciprocity	Reciprocity may not be an unalloyed good. Clientelism, cronyism, and nepotism are all forms of reciprocal relations that are generally seen as reflecting corruption. They can undermine resilience through misdirecting relief and development projects towards those favoured by elites, rather than those in the greatest need.
Unresponsive linking capital	Governance regimes characterised by limited political accountability, barriers to civil society movements, and top-down, communication channels can create passive and dependent citizenries (suppressing collective action). These regimes tend to plan and deliver disaster preparation and recovery schemes that are disconnected from the conditions and needs of local communities.
The conservative nature of social capital	Social capital underpins social cooperation, norm-conformance, and the maintenance of shared belief systems and social practices. This contrasts with ideals of social change and transformation. Whether conservatism is positive or negatively related to resilience depends on the *content* of the norms, belief systems and practices that social capital supports.

Table 3: A typology setting out the "dark side" of social capital in relation to hazard resilience

Social norms (content)	The *content* of social norms, conventions, and customs play a crucial role in shaping the capacity of individuals and groups to anticipate, adapt to, and recover from external shocks. Norm-content – as opposed to the extent to which norms are shared within a community – is not explicitly accounted for within the concept and literature of social capital.
Mental models of risk	Shared beliefs, experiences, and social memories about risks shapes the (re)interpretation, propagation and amplification of hazard signals, and strongly conditions perceptions of appropriate adaptation, mitigation and recovery options. The content of beliefs in relation to hazards or risks – whether derived from social memories or direct experience – is orthogonal to the social capital concept.
Shared expectations for collective action	Shared beliefs in a community's capacity to act in pursuit of a given end are a crucial mechanism for mobilising social capital in the form of collective action. Otherwise, the resources embedded in social networks may lie dormant. Explicit notions of agency are not well reflected in either the theory or empirical work surrounding social capital.
Network functions	Networks fulfil different kinds of functions – some generic (*e.g.* information sharing), some specific (*e.g.* land sharing networks) – and the range and combination of functions fulfilled by the set of networks within a community will shape resilience levels. However, social networks are treated as task-independent structures within much of the social capital and resilience literature, rather than as structures that are maintained to fulfil towards specific functions that require particular kinds of resources and forms of collective action.

Table 4: Properties of social networks that shape resilience, but that are orthogonal to social capital theories